

Investigation of Learning Model of Welding Practices in 3G SMAW Position Welder Competency Formation in Vocational High School

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Received September 10, 2019; Revised October 12, 2019; Accepted October 22, 2019

Abstract This study aims to: (1) uncover the learning model applied in 3G SMAW welder competence formation in SMK YP Gajah Mada Palembang and (2) determine the effectiveness of the applied learning model. This research is a descriptive study with interviews and documentation of data collection techniques. The results of the study are: (1) The learning model used to form 3G position welder competencies in students is a project-based learning model, (2) The learning model in SMK YP Gajah Mada Palembang has been effectively applied viewed from the percentage of pass students in competency test of expertise. In reverse, welding activities had not been effective to form 3G Position SMAW welding skills. The main instrument in welding practices is welding machine, meanwhile, SMK YP Gajah Mada Palembang only operates 4 welding machines that can be used with a ratio of 1 machine for 8 people. Consumables for 32 students per semester in welding practices are iron plate \pm 100-150 kg, grinding blade 7-8 pieces/semester, electrodes \pm 11-12 boxes/semester and time consumed for welding practices for entire 1 semester 17 times meetings with a total time of 98 hours or 4,410 minutes.

Keywords: *project-based Learning Model, SMAW welder competencies*

Cite This Article: Eliza Bahora, and Mujiyono, "Investigation of Learning Model of Welding Practices in 3G SMAW Position Welder Competency Formation in Vocational High School." *American Journal of Educational Research*, vol. 7, no. 10 (2019): 725-730. doi: 10.12691/education-7-10-8.

1. Introduction

Vocational education emphasizes the development of academic abilities and professional skills as a provision to enter the workforce. (Ministerial Regulation of Education and Culture No. 29 of 1990). Vocational School is a school which has 7 areas of expertise, including technology and engineering expertise (Director General of Primary and Secondary Education Management No. 06/ /D.D5/KK/2018) [1]. SMK YP Gajah Mada is a Vocational School with technology and engineering expertise which has 5 expertise programs, among the expertise program is welding engineering. One of the competencies formed is vertical position welder (3G) competence with the process of Shielded Metal Arc Welding (SMAW).

The formation of 3G SMAW welding competencies should be through learning model. According to Ministerial Regulation of Education and Culture No. 103 of 2014, learning models that applicable to Vocational Schools are Inquiry Learning model, Problem Based Learning model, Project Based Learning model, Production Based Training learning model. The Inquiry Learning model is usually more suitable for mathematics subject but can be alternative in other subjects according to the characteristics of the basic competencies or the

learning materials. The steps of this model are, 1) Observing various natural phenomena, 2) Questioning about the phenomena encountered, 3) Submitting hypothesis or possible answers, 4) Collecting data related to the hypothesis or questions, 5) Formulating conclusions based on data that has been processed or analyzed.

Problem Based Learning (PBL) Model, this learning model aims to stimulate students to learn through various real problems in daily life associated with knowledge that has been or will be learned through the following learning steps: According to Rusman ([2]: 243) the steps of the problem-based learning model are: 1) Giving orientation regarding problems to students.; 2) Organizing students in learning; 3) Helping investigate individually or in groups; 4) Developing and presenting works; 5) Analyzing and evaluating.

Project-Based Learning (PjBL) model Made Wena ([3]: 144) states "Project-Based Learning is classroom learning involving project work, this model aims to find learning that focuses on the complex problems required by students in conducting investigations and guiding students in collaborative projects that integrate a variety of subjects (materials) within the curriculum. The steps in project-based learning are: 1) Preparing questions or assigning projects. 2) Designing project planning. 3) Developing schedule for projects. 4) Monitoring projects activities and progress. 5) Examining results. 6) Evaluating activities.

The application of the Production Based Training Learning Model is to prepare students to have work competencies related to technical competencies and the ability to collaborate according to the demands of the work environment. The steps of the production-based training learning model include: 1) Planning products, 2) Implementing the production processes, 3) Evaluating products and 4) Developing marketing plans (Adapted from Ganefri [4]: G.Y. Jenkins, Hospitality (2005)).

Based on observations at SMK YP Gajah Mada, the learning model has been applied to form the competence of welding engineering expertise, but the specified models.

2. Research Methods

This research used descriptive qualitative method by using observation, documentation and interview data collection techniques, which present accurate and objective information of 3G position SMAW welding competencies implementation in vocational high school. This study does not test any hypotheses but rather describes phenomena that occur in the field.

This research was carried out on welding program competencies expertise in SMK YP Gajah Mada Palembang grade 3. The research was conducted in the even semester of the 2018/2019 academic year.

The research subject was students of Welding Program grade 3. Data collection techniques were carried out with preliminary observations in January 2019 and supported by interview, observation, and documentation.

3. Results And Discussion

Learning model is a pattern used as a guide to planning effective learning in class or tutorial. According to Arend

in (Suprijono [5]: 41), learning model refers to the approach, learning objectives, stages in learning activities, and classroom management.

After conducting research using descriptive method, learning model in teaching and learning process was obtained. The following are the results of the learning model at SMK YP Gajah Mada Palembang by using this method.

The welding program in SMK YP Gajah Mada grade 3 using Shielded Metal Arc Welding (SMAW) allocated 12 hours of learning time per week with each lesson hour was 45 minutes. SMK YP Gajah Mada Palembang has 4 teachers for welding program, 3 teachers are bachelor's degree and 1 teacher is master's degree. The age of teachers ranging from 30-55 years, thus, it is ideal for learning process. Classes for welding program in SMK YP Gajah Mada Palembang consist of 1 class for grade 1, 1 class for grade 2 and 1 class for grade 3. For grade 3, students taking credit for welding competency were 32 students and consisted of all male students.

The welding workshop only has one workshop, inside the workshop contains a main room as study room, instruments storage room, teachers room, and welding process room. Material cutting, grinding machine, and sink are located in front of the classroom. In SMK YP Gajah Mada Palembang, the welding workshop has chairs and tables provided for teachers and students. Seats in the main room are 20 chairs and 5 long tables with chairs made of plastic and tables made of wood. There are 2 tables and 3 chairs for teachers in the welding room. The instruments storage for welding practices is located in the instruments storage room with one table and one chair for the toolman who watches over the room. The following are the learning processes taking place in welding program of SMK YP Gajah Mada Palembang.

Existed learning model or regular learning	Meeting 1 Introduction to SMAW regular welding theory	Meeting 2 Theory of SMAW welding	Meeting 3 Theory of SMAW welding
Consumables	The absence of required materials Time = 6x45	The absence of required materials Time = 6x45	The absence of required materials Time = 6x45
HR (Teacher)	1 teacher/32 students	1 teacher/32 students	1 teacher/32 students
Facility	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine
Jobsheet			

Figure 1. Learning model for meeting 1-3

Existed learning model or regular learning	<u>Meeting 4</u> Theory of SMAW welding	<u>Meeting 5</u> Materials cutting	<u>Meeting 6</u> Job 1 Practice shop talk ± 10min -demo ± 20 mi -practice ±200mi -assessment ± 15min -closing ± 10 min
Consumables	Time = 6x45	Required material: plat Time = 6x45	Material= ½ kg / student Electrode = 3-6 rod /student
HR (Teacher)	1 teacher/32 students	1 teacher/32 students	1 teacher/32 students
Facility	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine
Jobsheet			

Figure 2. Learning model for meeting 4-6

Existed learning model or regular learning	<u>Meeting 7</u> Job 1 Practice (Welding vertical up line) - practice ± 230 min - assessment ± 15 min - closing ± 10 min	<u>Meeting 8</u> Job 1 Practice (Welding vertical up line) - practice ± 230 min - assessment ± 15 min - closing ± 10 min	<u>Meeting 9</u> Job 1 Practice (Welding vertical up line) - practice ± 230 min - assessment ± 15 min - closing ± 10 min
Consumables	Material= ½ kg / student Electrode = 3-6 rod /student	Material= ½ kg / student Electrode = 3-6 rod /student	Material= ½ kg / student Electrode = 3-6 rod /student
HR (Teacher)	1 teacher/32 students	1 teacher/32 students	1 teacher/32 students
Facility	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine
Jobsheet	Welding vertical up line	Welding vertical up line	Welding vertical up line

Figure 3. Learning model for meeting 7-9

Existed learning model or regular learning	<u>Meeting 10</u> Job 1 Retake Test - practice ± 230min - assessment ± 15 min - closing ± 10 min	<u>Meeting 11</u> Extra Job Practice - shop talk ± 10 min - demo ± 20 min - practice ± 200 min - assessment ± 25 min - closing ± 10 min	<u>Meeting 12</u> Job 2 Practice - shop talk ± 10 min - demo ± 20 min - practice ± 200 min - assessment ± 15min - closing ± 10 min
Consumables	Material= 0 kg Electrode = 3-6 rod/student	Material= 1 kg /student Electrode = 3-6 rod/student	Material= 1 kg /student Electrode = 4-8 rod/student
HR (Teacher)	1 teacher/32 students	1 teacher/32 students	1 teacher/32 students
Facility	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine
Jobsheet			Welding overhead line

Figure 4. Learning model for meeting 10-12

Existed learning model or regular learning	<u>Meeting 13</u> Job 2 Practice - practice ± 230 min - assessment ± 15min - closing ± 10 min	<u>Meeting 14</u> Job 2 Practice - practice ± 230 min - assessment ± 15 min - closing ± 10 min	<u>Meeting 15</u> Job 2 Practice - practice ± 230 min - assessment ± 15 min - closing ± 10 min
Consumables	Material= 1 kg/student Electrode = 3-6 rod/student	Material= 1 kg /student Electrode = 3-6 rod/student	Material= 1 kg /student Electrode = 4-8 rod/student
HR (Teacher)	1 teacher/32 students	1 teacher/32 students	1 teacher/32 students
Facility	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1 machine
Jobsheet			Welding overhead line

Figure 5. Learning model for meeting 13-15

Existed learning model or regular learning	Meeting 16 Job 2 Retake test - Practice ± 230 min - assessment ± 15 min - closing ± 10 min	Meeting 17 Extra Job Practice - shop talk ± 10 min - demo ± 20 min - practice ± 200 min - assessment ± 15 min - closing ± 10 min
Consumables	Material= 0 kg Electrode = 4-8 rod/student	Material= 1 kg Electrode = 4-8 rod/student
HR (Teacher)	1 teacher/32 students	1 teacher/32 students
Facility	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1	Total of students = 32 Total of machine = 4 Ratio = 7-8 for 1
Jobsheet		

Figure 6. Learning Model for meeting 16-17

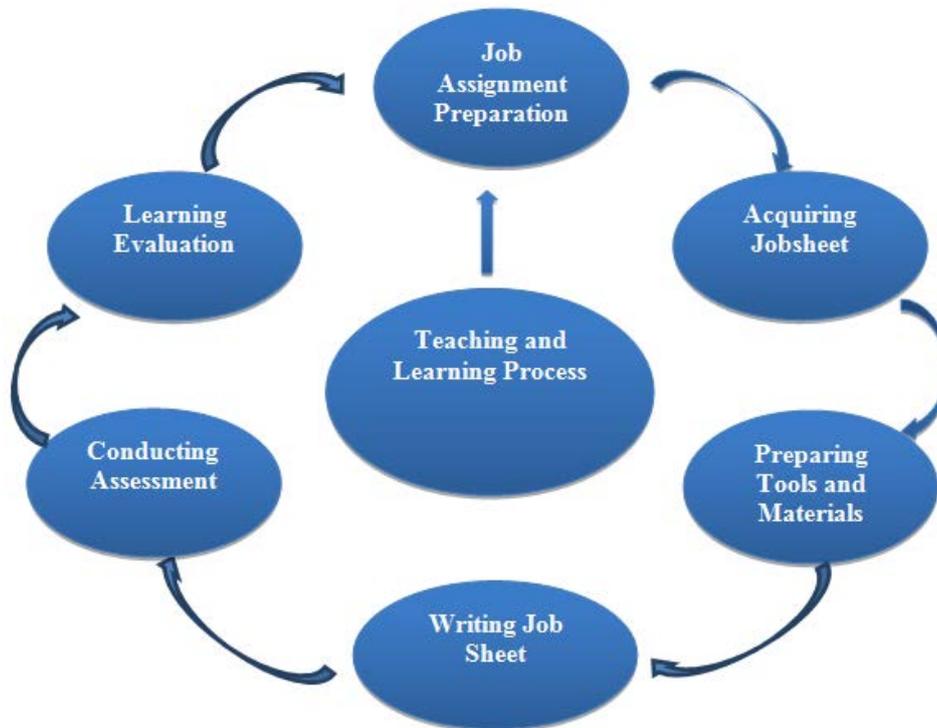


Figure 7. Model of Teaching and Learning Process

Table 1. Compatibility of applied learning model

Learning Model	Teaching and Learning Process					
	Job Assignment Preparation	Acquiring Jobsheet	Preparing Tools and Materials	Writing Job Sheet	Conducting Assessment	Learning Evaluation
Project-Based learning	√	√	√	√	√	√
Production Based Training	√	X	X	√	√	X
Inquiry Learning	√	X	X	X	X	X
Problem Based Learning	√	X	X	X	X	√

Based on objectives and steps of the Project-Based Learning model, this model is compatible with the practical learning activities in welding program in SMK YP Gajah Mada Palembang because it aims to form students in expertise competencies.

The Production Based Training learning model has no compatibility with the practice learning activities because the objectives and steps of this learning model are not in accordance with the practice learning process in welding program in SMK YP Gajah Mada Palembang.

The Inquiry Learning model has no compatibility with practice learning model because the objectives and steps of this model are not in accordance with the practical learning activities in welding program in SMK YP Gajah Mada Palembang.

Judging from the objectives and steps of the Problem Based Learning model, this model has no compatibility with the practical learning activities in welding program in SMK YP Gajah Mada Palembang.

Based on the explanation of the learning model which has been applied in SMK YP Gajah Mada Palembang, it can be concluded that SMK YP Gajah Mada used Project Based Learning model in accordance with the steps of the learning model and phenomena encountered in the practice.

Every school with expertise program and contains practical learning must be able to calculate the need to use the materials. Each student needs 2 pairs of material (4 materials) with the size of 20 x 7cm and height of 1 cm or 2.00 kg for job 1 practice, and requires 2 pairs of material (4 materials) with the size of 16 x 7 cm and height of 3.27 cm or 4.00 kg for job 2 practice.

The competency test of grade 3 students of welding program in SMK YP Gajah Mada Palembang was held on April 5-22, 2019, which was conducted in the welding program workshop in SMK YP Gajah Mada Palembang.

There were 32 students out of 33 who took the competency examination. 1 student did not take part from the beginning until the very end of the competency examination. Teachers who supervised the implementation of competency examination were 4 and supervisor from Industrial Environment. On one day of examination, there were 3 students conducting practice, 1 teacher and 1 supervisor from Industrial Environment. The time consumed to administer the competency was from 6:45 a.m. to 04:45 p.m. which was completed in the welding workshop of SMK YP Gajah Mada.

The competency test of welding program students had several assessments with standards, namely the Indonesian Work Standard Competency. Based on the results of the welding program competency test, there were some students retaking exam process due to unrequired scores based on criteria/competencies in welding program competencies.

Table 2. List of Competency Test Students

No.	Category	Total of Students
1	Pass Students	28
2	Retake Students	4
Total of students		32

32 students took the competency test and 4 of them retook the test. Remedial test was conducted on April 23-24, 2019 with the same activities from competency test before. Students were trained to complete the jobsheet with the guidance of teachers. Thus, after remedial test students were able to get certificate of welding program.

4. Conclusions

Based on the data obtained, the following are the conclusions. First, the learning model used in the competency of welding program in SMK YP Gajah Mada Palembang is a project-based learning model that is quite effective to be carried out to form the 3G position SMAW welder competencies for students in SMK YP Gajah Mada Palembang.

Second, with the applied learning model, the consumables and time spent to form the competency of welder program students in SMK YP Gajah Mada Palembang were; RD-260 electrodes \pm 11-12 boxes / semester, grinding blades \pm 7-8 pieces / semester, iron plates \pm 100-150 Kg / Semester and time consumed for welding practice for 1 semester consisting of 17 meetings with a total time taken 98 hours or 4,410 minutes.

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